

What is claimed is;

1. A battery pack malfunction detection apparatus for detecting a malfunction in a battery pack constituted by connecting in series a plurality of cells, comprising:

5 detection terminals each connected to either of two terminals of one of the plurality of cells;

malfunction detection circuits each provided in correspondence to one of the plurality of cells to detect a malfunction of a corresponding cell based upon a voltage
10 between the detection terminals;

a plurality of shorting circuits that short every other pair of detection terminals;

a control circuit that engages the shorting circuits in operation; and

15 a disconnection detection circuit that detects a disconnection at a connecting line between a given cell and a corresponding detection terminal based upon signals output from the malfunction detection circuits when the control circuit engages the shorting circuits in operation.

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2. A battery pack malfunction detection apparatus according to claim 1, wherein:

the shorting circuits each include a semiconductor switch so as to short the detection terminals by turning
25 on/off the semiconductor switch.

3. A battery pack malfunction detection apparatus
according to claim 1, wherein:

the control circuit simultaneously controls all the
5 shorting circuits.

4. A battery pack malfunction detection apparatus
according to claim 1, wherein:

the control circuit individually controls the shorting
10 circuits so as to identify a location of a disconnection.

5. A battery pack malfunction detection apparatus
according to claim 1, wherein:

the shorting circuits also function as current bypass
15 circuits each of which partially bypasses a current flowing
to a corresponding cell when the voltage between the detection
terminals becomes equal to or higher than a first
predetermined voltage.

20 6. A battery pack malfunction detection apparatus
according to claim 1, wherein:

the malfunction detection circuits each detect an
overcharged state in the corresponding cell by comparing the
voltage between the detection terminals and a second
25 predetermined voltage and detects an over-discharged state

in the corresponding cell by comparing the voltage between the detection terminals and a third predetermined voltage; and

the disconnection detection circuit detects a
5 disconnection if a malfunction detection circuit outputs a signal indicating an overcharged state or an over-discharged state in the corresponding cell when the control circuit engages the shorting circuits in operation.

10 7. A battery pack malfunction detection apparatus according to claim 1, further comprising:

opening circuits each provided for one of cells at which the shorting circuits are not provided, so as to open the detection terminals, wherein;

15 the control circuit engages the open circuits in operation concurrently when the shorting circuits are engaged in operation; and

the disconnection detection circuit detects a
disconnection of a connecting line between a cell and a
20 corresponding detection terminal based upon signals output from the malfunction detection circuits when the control circuit engages the shorting circuits and the open circuits in operation.

25 8. A battery pack malfunction detection apparatus

according to claim 1, further comprising:

current bypass circuits each provided in
correspondence to one of the plurality of cells to partially
bypass a current flowing to the corresponding cell as the
5 voltage between the detection terminals becomes equal to or
higher than a first predetermined voltage and a semiconductor
switch connected between the detection terminals enters an
ON state.

10 9. A method of detecting a malfunction of a battery pack
constituted by connecting in series a plurality of cells,
wherein:

shorting detection terminals alternately among
detection terminals each provided in correspondence to either
15 of two terminals of one of the plurality of cells; and

detecting a disconnection of a connecting line between
a cell and a corresponding detection terminal based upon
signals output from malfunction detection circuits each
provided to detect a malfunction of the corresponding cell
20 based upon a voltage between the detection terminals when the
detection terminals at alternate cells are shorted.